

Evaluation of the Effect of Regional Integration on Economic Growth—— Empirical Study on Beijing Tianjin Hebei Economic Circle Based on Synthetic Control Method

Yuan Zeng ¹ and Wenbo Deng ^{2,*}

¹ College of Business Administration, Heyuan Polytechnic, Heyuan 517000, China

² College of Economic and Trade, Guangdong Eco-Engineering Polytechnic, Guangzhou 510520, China

Abstract: Under the dual background of the new normal of China's economic growth slowdown and the high attention paid to the coordinated development of regional economy, whether the regional integrated development policy can promote the common growth of regional economy is worth in-depth discussion. This paper collects the panel data of 27 provinces (autonomous regions) and 19 sub provincial cities in China from 2010 to 2018, and uses the synthetic control method to conduct an empirical study on the economic effect of Beijing Tianjin Hebei integrated coordinated development plan. The results show that: the impact effect of Beijing Tianjin Hebei integration coordinated development planning has obvious heterogeneity: It has a positive effect on the economic growth of Beijing; It has a negative effect on the economic growth of Hebei Province. The economic growth of Tianjin is positive in the short term and negative in the long term. The research conclusion of this paper can provide reference for compiling regional integration development plans and promoting coordinated development of regional economy.

Keywords: regional integration; Beijing Tianjin Hebei Economic Circle; economic growth; synthetic control method

1. Introduction

Regional integration is conducive to breaking administrative barriers and promoting the reallocation and integration of resource elements. However, in the process of regional integration, the failure of government competition and coordination mechanism often leads to problems such as urban positioning error, improper industrial division, repeated construction, inefficient operation, etc. Regional development planning is an important means to solve the above problems and effectively promote regional economic development. Efficient development planning can promote regional policy interaction, resource sharing, industrial layout rationalization, market integration, and achieve coordinated and balanced development of regional economy.

At present, many scholars have studied whether the regional integration development policy can promote regional economic growth through empirical methods, but no consensus has been reached. Liu Ruiming et al. (2015), based on the research method of PSM-DID, found that the western development policy has a significant negative effect on regional economic growth [1]; Li Guoping (2019) conducted an empirical study on the western region using the synthetic control method, and found that the economic zone planning has promoted the eco-

conomic growth of the western region as a whole [2]. Scholars represented by Liu Naiquan believe that the regional integration expansion policy has promoted the economic growth of the Yangtze River Delta [3]; However, Wu Jun and others have reached the opposite conclusion [4].

The two cities and one province in Beijing Tianjin Hebei region are geographically connected, economically integrated, and have the basic conditions for coordinated development. To this end, the Central Committee of the Communist Party of China and the State Council issued the Outline of the Beijing Tianjin Hebei Coordinated Development Plan in April 2015, which requires to promote the optimization of regional economic structure, promote the economic development of underdeveloped areas in Hebei Province, narrow the gap between the economic development level of Beijing and Tianjin, and become a new engine of national innovation driven economic growth. An Jingwen (2019) pointed out that the quality of economic growth in the Beijing Tianjin Hebei metropolitan area is generally on the rise, but there are some regional differences [5]. Then, under the dual background of the new normal of China's slowing economic growth and the highly concerned coordinated development of regional economy, does the Beijing Tianjin Hebei Coordinated Development Planning Outline, as a programmatic document, promote the coordinated development within the region to achieve common economic growth? Is there any heterogeneity in the impact on regional economy? These issues deserve further discussion.

For this reason, this study selected the Beijing Tianjin Hebei Economic Circle as the research object, took the Beijing Tianjin Hebei Coordinated Development Planning Outline released in April 2015 as a quasi natural experiment, collected panel data from 27 provinces (regions) and 19 cities above the sub provincial level in China from 2010 to 2018, and used the synthetic control method to build a model to conduct empirical research on the economic effects of policies. The marginal contribution of this study is as follows: (1) This study uses the synthetic control method to build a model for the first time to evaluate the policy effect of the development planning of the Beijing Tianjin Hebei economic circle, which can scientifically reflect the net effect of the policy impact on the Beijing Tianjin Hebei region. (2) In this study, 26 provinces (districts) across the country are taken as the control group of policy impact effects in Hebei Province, and 17 cities at or above the sub provincial level are taken as the control groups of policy impact effects in Beijing and Tianjin, reflecting regional differences, which can more accurately estimate the composite unit forecast value of unit economic growth in the experimental group.

2. Research Method and Variable Description

There are mainly two methods to estimate the net effect of policy in academia: synthetic control method and double difference method. Among them, the synthetic control method (Abadie and Gardeazabal, 2003) can avoid the problem of subjectively selecting control group samples and solve the endogenous problem to a certain extent. This method selects areas similar to the research object but not affected by the policy as the control group [6], selects specific evaluation variables and main factors affecting evaluation variables, constructs a prediction model, and gives different weights to control group units, Fit the counterfactual units similar to the research object before the policy implementation, and further compare the actual value of the evaluation variables of the research object after the policy implementation with the predicted value of the evaluation variables of the counterfactual unit to evaluate the policy effect [7]. The synthetic control method and variable selection are described below.

2.1. research method

If the economic growth value of $J+1$ regions in the $t \in [1, T]$ period is observed, the first region is the region (processing unit) impacted by the regional development planning policy at T_0 ($1 \leq T_0 \leq T$), and the other J regions are the regions not impacted by the policy (control unit). Define $Y_{j,t}^H$ as the actual value of economic growth in region j impacted by the policy, and $Y_{j,t}^I$ as the predicted value of economic growth in region j not impacted by the policy. The treatment effect of Beijing Tianjin Hebei development planning policy on the impacted region β_j , $t = Y_{j,t}^H - Y_{j,t}^I$. When $t \in [1, T_0]$, the synthetic control unit will fit the synthetic unit prediction value of region j according to the actual value of region j and its influencing factors $\beta_j, t=0$. When $t \in [T_0, T]$, if $\beta_j, t > 0$ indicates that the Beijing Tianjin Hebei development planning policy has a positive effect on the economic growth of the

processing unit; If $\beta_{j,t} < 0$ indicates that the Beijing Tianjin Hebei development planning policy has a negative effect on the economic growth of the processing unit; If $\beta_{j,t} = 0$, it means that the Beijing Tianjin Hebei development planning policy has no impact on the economic growth of the target region. The research objective of synthetic control engine is to estimate $\beta_{j,t}$, for the processing unit affected by the Beijing Tianjin Hebei development planning policy at time point T_0 , its actual economic growth value $Y_{j,t}^H$ can be directly observed, but its composite unit's economic growth prediction value $Y_{j,t}^I$ after time point T_0 cannot be observed. The synthetic control method can estimate the composite unit's economic growth prediction value $Y_{j,t}^I$ according to the model proposed by Abadie et al. (2010) [8].

$$Y_{j,t}^I = \alpha_t + \theta_j Z_j + \lambda_j \mu_j + \varepsilon_{jt} \tag{1}$$

In formula (1), α_t is the time fixed effect that affects regional economic growth; Z_j is $(r \times 1)$ Dimension vector, representing the observable control variable of city j that is not impacted by Beijing Tianjin Hebei development planning policy; μ_j is $(F \times 1)$ Dimension vector, representing unobservable regional fixed effects; ε_{jt} is the temporary impact that cannot be observed in each region, with the mean value of 0; coefficient θ is a $(1 \times r)$ Dimension vector, which is the estimated parameter of control variable Z_j ; coefficient λ is a $(1 \times F)$ dimension vector, which is the common factor of fixed effect μ_j in the unobservable area.

The synthetic control method weights the control unit groups to fit the characteristics of the predicted values of the processing units. Therefore, we need to get a $(J \times 1)$ The weight vector of dimension $W (w_2, \dots, w_{j+1})$ 'satisfies $w_2 + \dots + w_{j+1} = 1$, and $W_j \geq 0$. The vector W represents the composite control combination of the processing unit area under the impact of the Beijing Tianjin Hebei development planning policy; While w_j is used to measure the composite contribution rate of the control unit group area to the processing unit, the predictive variables of composite control are:

$$\sum_{j=2}^{J+1} w_j Y_{j,t}^I = \alpha_t + \theta_j \sum_{j=2}^{J+1} w_j Z_j + \lambda_j \sum_{j=2}^{J+1} w_j \mu_j + \sum_{j=2}^{J+1} w_j \varepsilon_{jt} \tag{2}$$

If there is a vector group $(w_2^* \dots w_{j+1}^*)'$, make the processing unit $j=1$ impacted by the Beijing Tianjin Hebei development planning policy meet the following requirements:

$$\sum_{j=2}^{J+1} w_j^* Y_{j,1} = Y_{1,1}, \quad \sum_{j=2}^{J+1} w_j^* Y_{j,2} = Y_{1,2}, \quad \dots, \quad \sum_{j=2}^{J+1} w_j^* Y_{j,T_0} = Y_{1,T_0}, \quad \sum_{j=2}^{J+1} w_j^* Z_j = Z \tag{3}$$

If $\sum_{i=1}^{T_0} \lambda_i' \lambda_i$ is nonsingular, then there are:

$$Y_{j,t}^I - \sum_{j=2}^{J+1} w_j^* Y_{j,1} = \sum_{j=2}^{J+1} w_j^* \sum_{s=1}^{T_0} \lambda_j' (\sum_{j=1}^{T_0} \lambda_j' \lambda_j)^{-1} \lambda_j' (\varepsilon_{j,s} - \varepsilon_{1,s}) - \sum_{j=2}^{J+1} w_j^* (\varepsilon_{j,t} - \varepsilon_{1,t}) \tag{4}$$

Abadie's proof formula (4) shows that the mean value on the right side tends to 0, so $\sum_{j=2}^{J+1} w_j^* Y_{j,1}$ can be taken as an unbiased estimate of $Y_{j,t}^I$, and the estimated value of the impact of the economic growth of the processing unit impacted by the Beijing Tianjin Hebei development planning policy is:

$$\hat{\beta}_{1,t} = Y_{1,t} - \sum_{j=2}^{j+1} w_j^* Y_{j,1}, \quad t \in [T_0, T] \tag{5}$$

The key to obtaining the unbiased estimate of $\hat{\beta}_{1,t}$ is the existence of a vector group $(w_2^* \dots w_{j+1}^*)'$ that makes formula (3) hold. Abadie determines W^* by minimizing the distance $\|X_1 - X_0 W\|$ between X_1 and $X_0 W$, where X_1 is the eigenvector before the implementation of the Beijing Tianjin Hebei development planning policy, and X_0 is the $(K \times J)$ matrix. In general, the distance function is:

$$\|X_1 - X_0 W\|_v = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \tag{6}$$

In equation (6), V is a $(K \times K)$ symmetric positive semidefinite matrix. The optimal choice of V is to give reasonable weights to X_1 and X_0 variables, so as to ensure that before the implementation of the Beijing Tianjin Hebei development planning policy ($t \in [1, T_0]$), the weighted economic growth forecast value of the processing unit ($j=1$) matches the actual economic growth value of the unit in the corresponding year as much as possible.

2.2. Variable selection and data description

This study assesses the policy effect of the 2015 Beijing Tianjin Hebei Development Plan on economic growth, draws on the research results of Ye Xiuqun (2018) [9], takes GDP per capita as a variable to evaluate economic growth, and selects the following forecast variables that affect the evaluation variables: the level of fiscal expenditure (gov), measured by the proportion of government expenditure in total output; Capital investment (far), represented by the proportion of regional fixed asset investment in GDP; The industrialization level (sind) is measured by the proportion of the output value of the secondary industry in the total output; The development level of the tertiary industry (tind) is measured by the proportion of the output value of the tertiary industry in the total output; The degree of opening to the outside world (open) is measured by the proportion of total imports and exports in total output. If it is expressed in dollars, it is first converted according to the middle exchange rate of the year; Consumption level (com) is represented by the ratio of total retail sales of consumer goods to GDP. This study uses panel data from 27 provinces (autonomous regions) and 19 cities above sub provincial level in China from 2010 to 2018 to evaluate the effect of Beijing Tianjin Hebei development planning policies on promoting economic growth. The original data mainly comes from the China Statistical Yearbook and the Statistical Yearbooks of each province.

3. Empirical Analysis Results

The study evaluates the impact of Beijing Tianjin Hebei development planning policies on the economic growth of Beijing, Tianjin and Hebei in turn, and conducts a robustness test.

3.1. Evaluation of economic growth effect

The program package GDP per capita in stata15 is used as the evaluation variable of economic growth to estimate the synthetic control method. With Shanghai, Chongqing and 15 sub provincial cities as the control unit group, different weights are given to the control unit through the model and the composite Beijing and Tianjin are fitted; Using the same method, take 26 provinces (regions) outside Hebei Province as the control unit group to fit a composite Hebei Province, and the results are shown in Figure 1. The vertical dotted line represents the year 2015 when the Beijing Tianjin Hebei Development Plan was issued. The solid line represents the actual value path of real unit economic growth, and the dotted line represents the forecast path of synthetic unit economic growth. Figure 1a shows that before 2015, when the Beijing Tianjin Hebei Development Plan was issued, the actual economic growth path coincided with the composite Beijing growth path very high, indicating that the composite Beijing accurately fitted the actual economic growth value of Beijing before 2015. After 2015, the real value path of Beijing's economic growth has been on the path of synthesizing the predicted value of Beijing, which indicates that the policy has promoted the acceleration of Beijing's economic growth; Figure 1b shows that before 2015, the economic growth paths of actual and synthetic Tianjin had a high coincidence, indicating that synthetic Tianjin accurately fitted the actual economic growth values of Tianjin before 2015. After 2015, the difference between the two is: in 2016, the actual value of Tianjin's economic growth was higher than the synthetic forecast value of Tianjin's economic growth, after 2017, the actual value of Tianjin's economic growth began to decline, and by 2018, it was significantly lower than the synthetic forecast value of Tianjin's economic growth; Figure 1c shows that before 2015, the actual and synthetic economic growth paths of Hebei Province have a high degree of coincidence, indicating that synthetic Hebei Province can more accurately fit the actual economic growth value of Hebei Province before the implementation of the policy. The difference between the two after 2015 is that the actual and synthetic economic growth paths of Hebei Province in 2015-2016 are still highly coincident, and the trend of widening the difference only appears after 2017. By 2018, the actual economic growth value of Hebei Province is significantly lower than the synthetic economic growth forecast value of Hebei Province.

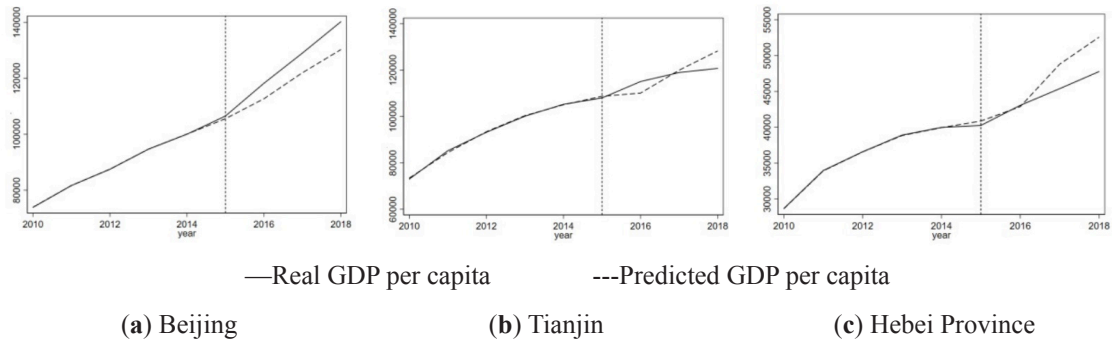


Figure 1. Policy Impact Effect of Beijing Tianjin Hebei Development Plan.

3.2. Robustness test

In order to ensure that the empirical analysis results are significant, this study uses the placebo test proposed by Abadie et al. The basic idea of this method is to assume that each control group unit is affected by the policy at the time point of policy implementation, and use the synthetic control method to test all units of the control group one by one. If the comparative test results show that the policy effect of the impacted processing unit is greater than the policy effect of the random unit, it indicates that the impact of the policy on the processing unit is significant.

Assuming that the control group of 17 cities in Beijing and Tianjin and the control group of 26 provinces in Hebei Province were impacted by policies consistent with the treatment group unit in 2015, the program package in STATA was used to conduct a placebo test, and the gap between the actual per capita GDP of each unit and the predicted per capita GDP of the corresponding synthesis unit was obtained. Referring to the practice of Abadie et al (2010) [8], the units whose RMSPE value is greater than 5 times of the synthetic RMSPE value in Tianjin are eliminated, and the predicted value of the synthetic unit is taken as the reference level (dotted line). The results are drawn with stata15 as shown in Figure 2.

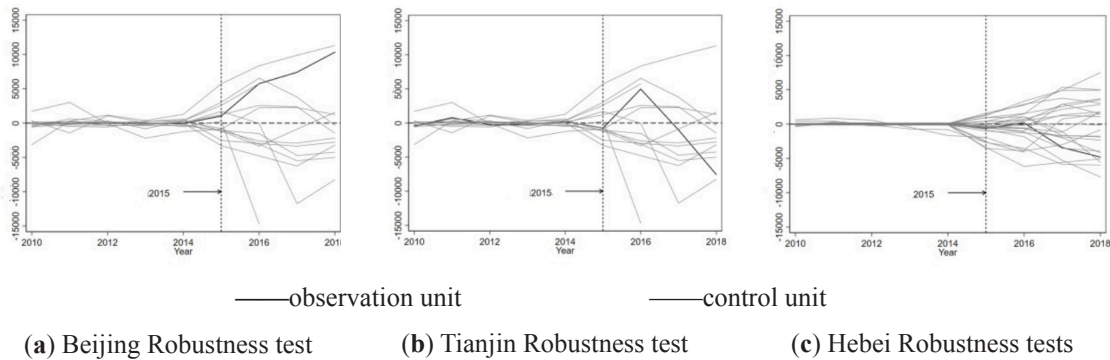


Figure 2. Robustness test of Impact Effect of Beijing Tianjin Hebei Development Plan.

Figure 2-a shows that the thick black solid line representing Beijing is basically above the thin solid line representing the control group unit, indicating that Beijing Tianjin Hebei has a significant positive impact on Beijing's economic growth; Figure 2-b shows that the thick black solid line representing Tianjin was above the thin solid line representing most control group units in 2016, but turned downward in 2017, but was below most of the thin solid lines in 2018, indicating that the policy had a significant positive impact effect on Tianjin in the early period, but had a significant negative impact effect in the later period; Figure 2-c shows that the thick black line representing Hebei Province in 2015–2016 was among the thin and solid lines representing most control group units. In 2017, the trend of economic growth began to decline, and in 2018, it was below the most thin and solid lines, indicating that the negative effects of policy shocks in Hebei Province in the later period were significant.

3.3. Further discussion

This study found that the impact of the Beijing Tianjin Hebei integration policy on the economic growth of Beijing, Tianjin and Hebei Province is significantly different, which has a positive impact on the most developed Beijing City, while a negative impact on Hebei Province, which has the lowest economic level. This conclusion is similar to the conclusion that Yang Rong et al. (2019) found that the difference in economic development levels among provinces (cities) in the Beijing Tianjin Hebei region is on the rise [10]. So why does the Beijing Tianjin Hebei integration policy have a negative impact on Hebei Province and Tianjin? Clarification of this issue can provide empirical support for regional integration to promote common economic growth. For this reason, the following will be analyzed in combination with existing literature.

The regional economic synergy of Beijing Tianjin Hebei is low, and the effect of promoting common economic growth through industrial division and collaboration is not obvious. Ma Xiao (2019) believed that the economic synergy effect of the whole Beijing Tianjin Hebei region was not obvious because of the weak economic synergy development ability of Tianjin and Hebei Province [11]. Shang Yongzhen and Chen Yao (2019) believed that Beijing, Tianjin and other cities in Hebei Province are at different stages of economic development. Beijing's service industry is developing rapidly, and most of its surrounding cities are still resource-based industries leading the development model; Due to the large difference in industrial gradient within the region, the first mover advantage of Beijing has absorbed more advantageous resources, thus further widening the regional economic development gap [12].

The main reasons why the economic growth of Tianjin after 2017 is not as expected are the unbalanced industrial structure, the reduction of fixed asset investment, the weak consumption growth and the insufficient financial support. The existing literature believes that the main reason for restraining the economic development of Tianjin is the unbalanced industrial structure [13–14]. Further from the consumption level, investment level and openness level, although the total import and export volume of Tianjin increased significantly in 2017 and 2018, its fixed asset investment decreased by 11.7% and 5.6% respectively in 2017 and 2018, and its total retail sales of social consumer goods increased by only 1.7% in 2017, but decreased by 3.4% in 2018. From the perspective of financial expenditure level, Tianjin's financial expenditure in 2017 and 2018 decreased by 11.3% and 5.5% respectively.

The main reasons for the negative impact of economic growth in Hebei Province are the unreasonable structure of human capital and the lagging effect of fixed asset investment. The agglomeration of Beijing Tianjin Hebei central cities has formed a negative spatial spillover effect on the surrounding cities, attracting the inflow of their human capital; The outflow of human capital from most cities in Hebei Province has hindered their economic growth [15]. Although the fiscal expenditure and fixed asset investment in Hebei Province have been steadily increasing year by year, due to the lagging effect of fixed asset investment in Hebei Province, its fixed asset investment has a short-term inhibitory effect on economic growth [16].

4. Conclusions and Suggestions

In order to further study whether the regional integration development policy has promoted the common economic growth and whether there is regional heterogeneity, this study takes the Beijing Tianjin Hebei Coordinated Development Planning Outline as a quasi natural experiment, collects panel data from 2010 to 2018, and uses the model constructed by the synthetic control method to evaluate the economic growth effects of Beijing, Tianjin and Hebei respectively. The empirical analysis shows that the regional integration development policy has obvious heterogeneity on regional economic growth, and the Beijing Tianjin Hebei development plan has a significant positive impact on Beijing's economic growth; It had a significant positive impact on the economic growth of Tianjin at first, but a significant negative impact later; It has a significant negative impact on the economic growth of Hebei Province.

Based on the research conclusions, the following suggestions are put forward: ① Improve the planning of industrial division and layout in Beijing Tianjin Hebei region. Formulate corresponding policies to encourage the transfer of labor-intensive industries to Hebei Province, and the transfer of high-tech industries with high dependence on foreign trade to Tianjin. ② Strengthen the talent and intellectual support for Hebei Province and

Tianjin. We will increase investment in and introduction of talent training in Hebei Province and Tianjin, give full play to the advantages of Beijing as the capital of talent gathering, provide more think tanks for Hebei Province and Tianjin, and promote industrial transformation and upgrading to high-end development. ③ Increase capital investment in Hebei Province and Tianjin. Avoid the siphon effect of Beijing on resources and factors, which leads to the lagging development of Hebei Province and Tianjin City; It is suggested to appropriately increase the financial transfer payment funds to Hebei Province and Tianjin City for infrastructure construction. ④ Accelerate the construction of Xiong'an New Area. In 2017, the central government proposed to build Xiong'an New Area in Baoding City, which is close to Beijing and Tianjin in Hebei Province, and issued the Outline of Hebei Xiong'an New Area Plan the following year, aiming to adjust and optimize the urban layout and spatial structure of Beijing, Tianjin and Hebei; It is suggested to accelerate the construction of the new area to accelerate the economic growth of Hebei Province and Tianjin.

Funding

Not applicable.

Author Contributions

Collected data, processed empirical data, presented empirical results, wrote the main part of the paper and proposed research conclusions, Y.Z.; presearch design, wrote the literature review and checked the article, W.D. All of the authors read and agreed to the published the final manuscript.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

References

- 1 Liu RM, Zhao RJ. Western Development: Growth Drive or Policy Trap -- Research Based on PSM-DID Method. *China Industrial Economy* 2015; **(06)**: 32–43.
- 2 Li GP, Li HW. Does Economic Zone Planning Promote Economic Growth in Western China——Research based on synthetic control method. *Economic Geography* 2019; **39 (03)**: 20–28.
- 3 Liu NQ, Wu Y. Can the expansion of the Yangtze River Delta promote the common growth of regional economy. *China Industrial Economy* 2017; **(06)**: 79–97.
- 4 Wu J, Yang Q. Research on the Border Effect of Yangtze River Delta Expansion and Economic Integration. *Contemporary Finance and Economics* 2015; **(07)**: 86–97.
- 5 An JW, Wang JH. Ma Ming Measurement of the quality of economic growth in the Beijing Tianjin Hebei metropolitan area from the perspective of the five development concepts. *Business Economics Research* 2019; **(17)**: 153–156.
- 6 Abadie A, Gardeazabal J. The economic costs of conflict: A Case Study of the Basque Country. *American Economic Review* 2003; **93 (1)**: 113–132.
- 7 Deng WB. Does the planning of economic zones promote common economic growth—— Empirical Study on Haixi Economic Zone Based on synthetic Control Method. *Journal of Zhaoqing University* 2020; **41 (04)**:

- 30–35.
- 8 Abadie, AD, Alexis, HJ. Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *Journal of the American Statistical Association* 2010; **105 (490)**: 495–505.
 - 9 Ye XQ. Pilot Free Trade Zones and Economic Growth: Empirical Research Based on Quasi natural Experiments. *Economic Review* 2018; **(04)**: 18–30.
 - 10 Yang R, Yang A, Li CX. Temporal and Spatial Evolution of Regional Economic Differences between Beijing, Tianjin and Hebei. *Business Economics Research* 2019; **(01)**: 160–162.
 - 11 Horse X. Evaluation of Beijing Tianjin Hebei regional economic synergy degree based on composite system synergy degree model. *Industrial Technology and Economy* 2019; **38 (05)**: 121–126.
 - 12 Shang YZ, Chen Y. Functional spatial division of labor and economic growth of urban agglomeration--based on comparative analysis of Beijing Tianjin Hebei and Yangtze River Delta urban agglomeration. *Exploration of Economic Issues* 2019; **(04)**: 77–83.
 - 13 Wu YQ, Sun JY, Han SS, Zhang H. Economic growth mode and phased characteristics of Beijing Tianjin Hebei. *Economics and Management* 2019; **33 (01)**: 4–8.
 - 14 An JW, Meng Z, Liang ZX, Pan YX. Convergence Measurement of Economic Growth in Beijing Tianjin Hebei Metropolitan Area. *Urban Issues* 2019; **(04)**: 66–71+103.
 - 15 Ren H, Li ZK. Influential Factors and Spatial Effects of Economic Growth of China's Three Urban Agglomerations. *Urban Issues* 2019; **(10)**: 63–68.
 - 16 Li B. Analysis on Investment Effect and Lagging Effect of Fixed Assets in Hebei Province. *Journal of Hebei Normal University (Philosophy and Social Sciences Edition)* 2006; **(03)**: 48–51.

